

CLAIMS

- 1 A process for extraction of zinc from a material containing one or more iron oxides and zinc oxide, said process including:
- 5 (a) heating a composite body of said material and a carbonaceous material in a reduction zone containing a reducing atmosphere at a temperature insufficient to effect melting of the iron in the material but at a temperature and for a time sufficient to form a reductant from said carbonaceous material and to reduce a predetermined amount of the zinc oxide to zinc vapour; and
- 10 (b) collecting said zinc vapour and cooling it to form liquefied or solid zinc.
- 2 A process according to claim 1, further including:
- (c) controlling said zinc vapour to substantially prevent or minimise its premature recondensation.
- 15 3 A process according to claim 2 wherein said controlling of the zinc vapour to substantially prevent or minimise its premature recondensation includes providing gas flow in said reduction zone arranged to drive said zinc vapour away from said reduction zone.
- 20 4 A process according to claim 3, wherein said gas flow in said reduction zone is generally downwardly and said vapour is driven by said gas flow laterally from the reduction zone.
- 5 A process according to any one of claims 1 to 4, further including:
- (d) reducing a predetermined amount of said iron oxides;

(e) further heating the reduced material from which zinc vapour has been collected to a temperature sufficient to effect melting of the iron therein; and

(f) recovering and cooling the molten iron.

5 6 A process according to claim 5, wherein waste heat and/or heated gases from said further heating are utilised in said formation of said zinc vapour.

7 A process according to claim 5 or 6, including providing a predetermined fluxing agent whereby to form a basic slag in said further heating step and to encourage desulphurization reactions.

10 8 A process according to claim 5, 6 or 7 wherein said respective heating steps are carried out in separate furnace chambers.

9 A process according to any one of claims 5 to 8, further including extracting lead from said material, wherein said further heating melts the lead, which is separated and recovered from the melt.

15 10 A process according to any preceding claim, wherein the material containing one or more iron oxides and zinc oxide is electric arc furnace (EAF) dust.

11 A process according to any preceding claim wherein said carbonaceous material is finely divided brown coal or peat.

20 12 A process according to any preceding claim, further including forming said composite body by mixing a carbonaceous material with the material containing one or more iron oxides and zinc oxide to produce a cohesive mass, and compacting the cohesive mass to produce the composite body.

25 13 A process according to any preceding claim wherein said composite body is a pellet.

14 A process according to claim 13 when appended to claim 12, including forming said pellet by extrusion of the cohesive mass.

15 A process according to any preceding claim wherein the amount of carbonaceous material in said composite body is such that, when
5 combusted in said heating step or steps, the carbonaceous material provides at least sufficient heat for its carbonisation and for reduction of the zinc and iron oxides and, if recovered, lead oxide, in said material containing one or more iron oxides and zinc oxide.

16 A process according to any preceding claim wherein, heating step (a) of the
10 inventive process is conducted in a furnace chamber.

17 Apparatus for extraction of zinc from a material containing one or more iron oxides and zinc oxide, including:

15 a first furnace chamber for receiving composite bodies that include said material and a carbonaceous material, which furnace chamber defines a reduction zone in which said composite bodies may be heated at a temperature insufficient to effect melting of the iron in the material but at a temperature and for a time sufficient to form a reductant from said carbonaceous material and to reduce a predetermined amount of the zinc oxide to zinc vapour;

20 means to collect said zinc vapour from the first furnace chamber;

means to receive said collected zinc vapour for cooling the vapour to form liquefied or solid zinc.

18 Apparatus according to claim 17, further including means for controlling said zinc vapour to substantially prevent or minimise its premature
25 recondensation.

- 19 Apparatus according to claim 18, wherein said means for controlling said zinc vapour includes means associated with said first furnace chamber whereby said zinc vapour is driven away from said reduction zone.
- 5 20 Apparatus according to claim 19, wherein said gas flow in said reduction zone is generally downwardly and said zinc vapour is driven by said gas flow laterally for the reduction zone.
- 21 Apparatus according to any one of claims 17 to 20, further including:
- 10 a second furnace chamber in communication with said first furnace chamber to receive therefrom reduced material from which said zinc vapour has been collected;
- heating means for further heating the recovered material in the second furnace chamber to a temperature sufficient to effect melting of the iron therein; and
- means to recover and cool the molten iron.
- 15 22 Apparatus according to claim 21 wherein said first and second furnace chambers are arranged so that waste heat and/or heated gases from said further heating are utilised in formation of said zinc vapour in the first furnace chamber.
- 20 23 Apparatus according to claim 21 or 22; further including means to tap slag from said second furnace chamber.
- 24 Apparatus according to claim 21, 22 or 23 further including means to tap molten lead from said second furnace chamber.
- 25 25 Apparatus according to any one of claims 21 to 24, wherein said second furnace chamber is vertically below the first furnace chamber such that said reduced material is continuously fed into the second furnace chamber under gravity.

- 26 Apparatus according to any one of claims 21 to 25, wherein said heating means is an external electrical heating means.
- 27 Apparatus according to any one of claims 17 to 26, wherein said means defining a cooling zone comprises a zinc vapour condenser in communication with an outlet from said reducing zone comprising the zinc vapour collecting means.
- 28 Apparatus according to claim 27, wherein said condenser is a zinc splash condenser.
- 29 Apparatus according to claim 27 or 28, wherein said condenser includes a main condenser chamber having an inlet for receiving zinc vapour positioned above the base of the main condenser chamber such that condensed zinc does not pass back into the furnace chamber.
- 30 Apparatus according to claim 27, 28 or 29, wherein said main condenser chamber surrounds a vapour conduit, the open end of which forms the vapour inlet, extending from said outlet from the reduction zone to a region of the condenser above its base.
- 31 Apparatus according to any one of claims 27 to 30, wherein a vapour conduit extends in a lateral direction from the furnace outlet into an upper region of the condenser chamber.
- 32 Apparatus according to any one of claims 17 to 31, including:
- a thermally insulated casing defining said first furnace chamber therein;
- one or more columns provided within said first furnace chamber, each column comprising a plurality of vertically orientated, vertically spaced, heat resistant tubes, wherein the cross-sectional area of each tube is smaller than that of an adjacent, lower tube, and wherein the ends of adjacent tubes are arranged so as to provide an annular space therebetween,

an inlet through which a combustible charge is fed into the uppermost tube,

an outlet from which reacted charge is removed from the lowermost tube;
and

5 a fluid conduit for conveying combustible volatiles evolved by heating said charge to a gas burning means for combustion, to thereby provide heat to said first furnace chamber.